Sleep, Trauma, Fantasy and Cognition in Dissociative Identity Disorder, Post-traumatic Stress Disorder and Healthy Controls: A Replication and Extension Study

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Abstract

Background. Two aetiology models for dissociative identity disorder (DID) have been proposed, namely a childhood Trauma Model and an iatrogenic or Fantasy model. A recent study indicated that sleep disturbances underlie dissociative symptomatology.

Objective. Our current study aims to test whether this finding can be replicated in an independent sample and to investigate if this finding still holds after correcting for childhood and adult traumatisation. An experimental working memory task is included to investigate how sleep disturbance, traumatisation, dissociation, and fantasy proneness impact cognitive functioning.

Methods. Three groups of participants were included – individuals with DID, individuals with post-traumatic stress disorder (PTSD), and matched healthy controls. Sleep disturbances were measured and compared between the groups along with measures of childhood and adult traumatisation, psychoform and somatoform [psychological and somatic] dissociative symptoms, and fantasy proneness. Cognitive capacity was assessed using a working memory task.

Results. When controlled for traumatic experiences, sleep disturbances did not predict dissociative symptoms. When controlled for sleep disturbance and fantasy proneness, childhood traumatisation did predict dissociative symptoms. Psychoform dissociative symptoms correlated with traumatic experiences more than with fantasy proneness. Working memory performance was similar among the participating groups. Propensity to fantasy did not discriminate individuals with DID and PTSD, and was a weak predictor of dissociative symptoms.

Conclusion. Whereas DID and PTSD are associated with sleep disturbances, these features do not statistically predict dissociative symptoms in these disorders when traumatic experiences are taken into account. Fantasy proneness is not excessive in DID and PTSD. Hence, we found no evidence that sleep disturbances, propensity to fantasy and abnormal working memory capacity explain dissociative symptoms in DID and PTSD. In sum, the relationship between sleep and dissociative symptoms disappeared when potentially traumatising events were controlled for.

Highlights of the article

Sleep disturbances do not predict pathological dissociation when controlling for traumatisation.

Cognitive performance similar in individuals with dissociative identity disorder, post-traumatic stress disorder and healthy controls.

Findings support a trauma model of dissociative symptoms.

1. Introduction

According to the DSM-5 dissociative identity disorder (DID) is characterized by having two or more distinct dissociative personality states in conjunction with the failure to integrate memory, consciousness and identity [1]. Each of these personality states is characterized by a way of thinking about the environment and the self, resulting in fluctuating perceptions which may impair normal cognitive functioning. Three core features present in DID are, among others, 'dissociative amnesia', that is the inability to recall key personal information, 'absorption'/imaginative escape and 'depersonalisation/derealisation' [1]. Despite the prevalence rates being similar to those seen in schizophrenia [2,3], DID remains under-researched and cognitive functioning mediating these three core features remain unknown.

DID is also under-diagnosed and the most disputed of psychiatric disorders [4]. Whether its aetiology is trauma-related, as described in a Trauma Model (TM) [5], or related to fantasy proneness, which is referred to as the Fantasy Model (FM) [5] (also known as the Sociocognitive model [6]) , is an ongoing debate [5,7–11]. The TM for DID explains dissociation and identity fragmentation as a reaction to early and prolonged traumatising experiences [9,12]. Consistent with this DID is associated with chronic emotional neglect, emotional abuse, physical abuse and neglect and/or sexual abuse starting in early childhood [13–18]. Furthermore, the presence of dissociative symptoms is highly contingent on childhood trauma history [19]. However, self-reported rates of trauma may be underreported due to knowingly withheld information to avoid painful recollection [20], or unknowingly withheld due to dissociative processes [21].

The FM posits that individuals with severe dissociative symptoms score high on fantasy proneness measures and report more cognitive impairments [22]. Consequently, individuals would be left with a cognitive vulnerability to iatrogenesis and this process distorts memory reports of traumatisation [23,24]. However, neurobiological research has failed to support this model, showing that high fantasy prone healthy controls instructed and motivated to simulate DID were not able to enact brain activation patterns and physiological activation of individuals with DID [25–27]. Research on cognitive functioning, dissociative symptoms and DID has produced conflicting results: some studies [28] on memory and dissociative disorders showed potential deficits in working memory of DID individuals, while several other studies documented that dissociation was linked to better task-

performance in working memory tasks accompanied by increased brain activation [29–31]. Consequently, research requires further replication and validation. [32].

Dissociative symptoms have been hypothetically linked to sleep-wake cycles in which "dreamlike mentation conquers the waking state" [33 p. 167], producing memory failures and driving dissociative experiences. It has also been proposed that sleep disturbances (such as hypnagogic hallucinations, nightmares, waking dreams and lucid dreams) are causally related to dissociative symptoms and cognitive failures [33]. Hence, sleep disturbances might undermine cognitive efficiency by reducing attention control and memory, whilst fuelling 'imaginative mentation' [33 p. 167]. This thought raised the idea that sleep disturbances are a "necessary and sufficient antecedent" for DID [33 p. 167].

In contrast, the TM maintains that these sleep disturbances may be a consequence of dissociative symptoms and actual traumatisation, for example due to nightmares. Van Heughten - van der Kloet et al. [34] explored the hypothesis that sleep predicts dissociative symptoms in a group of individuals with DID, a group with PTSD, and a healthy control group on the basis of an earlier study conducted in a non-clinical insomnia group [35]. Results showed that although DID and PTSD individuals did not differ in any respect, except for the severity of dissociative symptoms, a high score for unusual sleep experiences was the best statistical predictor of belonging to the DID group; the PTSD group was differentiated by markedly lower cognitive performance. Additionally, fantasy proneness, cognitive impairments, and sleep disturbances scores were higher in both diagnosed groups (DID and PTSD) when compared to those of healthy controls. The authors stated that the idea that DID is strongly related to PTSD fits well with their findings. Although traumatisation might have been the common factor, this was unfortunately not studied despite its possible link to sleep disturbances [12,35]. Of note, the authors of the original study offered the suggestion of adding measures of traumatic experiences as a future direction of study.

Therefore, several aspects of the study by van Heughten - van der Kloet et al. [34] require further investigation and replication [32]. Firstly, no trauma measure was included and it was therefore not possible to test a trauma-sleep-dissociation relationship. Secondly, the use of an experimental measure of cognitive capacity, instead of a self-report measure, would have been more suitable, as the authors also mention themselves [34 p. 3]. Thirdly, it would be of interest to study amnesia, absorption, and depersonalisation/derealisation, the three core features of psychogenic dissociation,

and somatoform dissociation in relation to cognitive functioning and sleep deprivation in DID. Finally, the correlation analyses in the original study [34] might be prone to methodological error because the analyses were performed across diagnosed groups and controls. Such analyses can lead to inflated results and spurious outcomes for the diagnosed groups [5].

The current study aimed to investigate whether previous findings can be replicated in a larger independent and carefully diagnosed sample of individuals with DID, a PTSD sample, and a healthy control group, while extending the study by including measures of traumatisation and an experimental measure of working memory. Therefore, this study allows for the investigating of the relationship between dissociation and sleep, trauma, fantasy, and cognitive performance. We hypothesized that (i) when correlation analyses are run within DID and PTSD groups only, to avoid spurious effects, sleep disturbances and fantasy proneness correlate less than traumatic experiences with dissociative symptoms, (ii) sleep disturbances do not predict dissociative symptoms when controlling for traumatic experiences, but traumatic experiences do predict dissociative symptom severity better than sleep disturbances or fantasy proneness, and that (iii) working memory performance in individuals with DID and PTSD is similar, but worse from performance in healthy controls.

2. Methods

2.1. Design and Participants

The questionnaire data were obtained as part of a larger study [9,17,18]. Only female participants volunteered to participate, and data of three groups was included: individuals with DID (n=17), individuals with PTSD (n=16), and healthy controls (HC) (n=16). Inclusion age of all three groups was 18-65 years. Other requirements were Dutch as the native language and ability to give informed consent according to Dutch legal regulations. Individuals with DID were recruited in the Netherlands by clinicians at treatment settings. The diagnosis was confirmed by ERSN and/or ND using the Structured Clinical Interview for DSM-IV Dissociative Disorders (SCID-D) [36]. If permission for video recording was given, the SCID-D interview was recorded, enabling an assessment of the interview by a second reviewer when necessary. The data from the DID participants' most prominent neutral personality state (NPS) [37], also known as "Apparently Normal Personality" [37], was included from all of the questionnaires and the N-Back task. This was for purpose of replicating the study by van Heughten - van der Kloet et al. [34]. For the group of individuals with PTSD, the diagnosis was confirmed by the researchers using the Clinician-Administered PTSD Scale (CAPS) Dutch translation according to the DSM-5 criteria [1]. 16 healthy control (HC) participants were recruited through leaflets, advertisements in newspapers, use of posters, and by word of mouth. Both PTSD and HC groups we carefully matched to the DID group for age, gender and level of education. The HC group was not told that they would serve as a control group for DID. Additional exclusion criteria for HC were: a high score of (psychoform/somatoform) dissociative symptoms (evaluated with the DES and SDQ-20, respectively), psychiatric disorder in the past or at present, or a high score on the TEC. All participants gave informed written consent in accordance with the Declaration of Helsinki and as dictated by ethics approval which was obtained from the Medical Ethical Committees of UMCG (Reference number: METC2008.211) and the AMC (Reference number: MEC09/155).

2.2 Questionnaires and tasks

All participants completed self-report questionnaires for trauma, dissociative symptoms, sleep deprivation and fantasy proneness. The Dissociative Experiences Scale (DES) [38,39] assesses the severity of psychoform dissociative symptoms. The Traumatic Experiences Checklist (TEC) assesses 25 types of adverse experiences, their duration, and the age at occurrence or onset. The Dutch

version of the Childhood Trauma Questionnaire (CTQ) [40,41], the 'Jeugd Trauma Vragenlijst' (JTV) [42], evaluates the frequency of childhood maltreatment (physical, emotional, sexual abuse and physical, emotional neglect). The Iowa Sleep Experience Survey (ISES) [43] assesses sleep disturbances. The Creative Experience Questionnaire (CEQ) [44] measures developmental antecedents of fantasy proneness, involvement in fantasy and daydreaming, and consequences of daydreaming.

All groups also completed a working memory task, namely the N-back task. The N-back task measures working memory capacity [45] through reaction times to a condition-specific instruction. Individuals viewed single capital letters presented onto a screen followed one after the other. They were instructed to respond by pressing a key, when the projected letter was the same as the one before (1-back), the same as the letter preceding the last shown letter (2-back), and the same as the preceding last two shown letters (3-back). Individuals were also required to respond to the letter X when presented on screen (0-back/baseline). A condition-specific instruction was shown each time a new trial block started. Each block consisted of 14 stimuli, with six targets. For each condition three blocks were presented. Each condition was presented three times, in a pseudo-randomized order, resulting in a total of 12 blocks of each 14 stimuli. Total duration of the task is approximately 7 minutes. The DID group had three participants who were unable to take part in the N-back task and one participant with missing values for the CTQ assessment, hence data of 14 DID participants for the N-back task and 16 for the CTQ were included in the current analyses.

2.3 Statistical analysis

The first and second hypothesis were tested using the questionnaire measures and one-way analysis of variance (ANOVA). Nonparametric Kruskal-Wallis tests and (post-hoc) Mann-Whitney tests were added because the data did not meet the assumption of normal distribution or heterogeneity of variance. As part of the ANOVA, Bonferroni post-hoc correction was applied. Effect sizes were calculated using Eta squared values by computing the Chi Square and dividing that by n-1. Pearson's partial correlation analyses were performed twice controlling for level of education: the first analysis included only the diagnosed samples to avoid spurious effects, whereas the second analysis included the total sample to reproduce the analyses method of the original paper (for extended analyses specifying the DES in terms of absorption, amnesia and depersonalisation/derealisation, the

Somatoform dissociation questionnaire [SDQ] see Part A of the Supplementary materials in tables S.1 and S.2. CEQ item-specific correlation analyses with these measures of dissociation are provided in Part B of the Supplementary materials).

Multiple linear regression analyses were applied to analyse predictability of traumatic experiences and sleep deprivation on dissociative symptoms. The main analysis was run on diagnosed individuals (DID and PTSD) to avoid spurious outcomes from including the healthy control sample. The multivariate regression was between measures of dissociative symptoms and the predictor variables traumatic experiences (TEC and CTQ total scores), sleep disturbances (ISES) and fantasy proneness (CEQ) (see Part C of Supplementary materials for sample size estimates).

For the third hypothesis, investigating working memory performance on the N-back task, we used a one-way ANOVA repeated measures in a between-subject design of group (DID, PTSD, and HC), condition (0-back, 1-back, 2-back and 3-back) and the Group x Condition. Furthermore, multiple linear regression analysis was carried out concerning reaction time (RT) and correct responses (CR). The regression involved examining the cumulative effect of all traumatisation (TEC and CTQ total scores), sleep (ISES) dissociative symptoms (DES) and fantasy measures (CEQ) on RT and CR.

3. Results

3.1 Summary of the main data

Table 1 displays the descriptive statistics for all questionnaires, that is dissociative symptoms (DES), traumatic experiences (TEC and CTQ), sleep disturbances (ISES) and fantasy proneness (CEQ). Somatoform and psychoform dissociative symptoms were highest in the DID group compared to PTSD and HC. Eta squared values indicated that 76% of DES score variance was explained by the groups. The CTQ (traumatic experiences) mirrored this pattern with 64% of variance explained by the groups, while the TEC (idem) indicated 80% of explained variance, whereby highest traumatic experiences score was found in the DID group for both CTQ and TEC. ISES (sleep measures) explained 46% of variance. Post-hoc analyses for the ISES showed that the DID and PTSD groups did not differ, but both groups differed significantly from the healthy controls (all $p<.001$). Similarly, fantasy proneness (CEQ) did not differ significantly between the DID and PTSD groups, but differed significantly between DID and HC ($p=.004$) and PTSD and HC ($p=.006$). However, the fantasy proneness variance explained by groups was only 22%.

3.2 Analysis

3.2.1 Hypothesis (i): Correlating sleep, dissociative symptoms and traumatic experiences

When only including the DID and PTSD groups, and not the HC group, the Pearson's partial correlation analysis between sleep measures and measures of dissociative symptoms did not give any significant results (see Table 2, part A). As presented in Table 2 part A, the correlations between traumatic experiences and dissociative symptoms were much stronger for both for TEC ($r=.664$, $p<.01$) and CTQ ($r=.651$, $p<.001$), than those of dissociative symptoms and fantasy proneness ($r=.387$, $p<.05$), while correlations with sleep deprivation was not significant. When HC were included in the analyses, sleep deprivation resulted in a significant positive association with dissociative symptoms ($r=.561$, $p<.001$) (see Table 2, part B; Figure 1), while the correlation strength of the CEQ was increased ($r=.561$, $p<.001$).

3.2.2 Hypothesis (ii): Predicting dissociative symptoms: traumatic experiences versus sleep disturbances

The multiple regression analysis including measures of sleep disturbances (ISES), traumatic experiences (TEC and CTQ total) and fantasy proneness (CEQ) showed that sleep disturbances and fantasy proneness are weaker predictor variables for dissociation symptoms than traumatic experiences in DID and PTSD individuals (results including all three groups of participants are provided in the supplementary materials, Table S.1). When including childhood or adult traumatic experiences (CTQ and TEC respectively) as a predictor variable of dissociative symptoms, we found greater coefficients of effect than sleep disturbances and fantasy proneness in predicting dissociative symptoms (see Table 3). Childhood traumatic experiences in particular were the most significant predictor variable for dissociative symptoms.

3.2.3 Hypothesis (iii): Cognitive performance

Testing whether dissociation, traumatisation or sleep disturbances predicted performance on the N-back working memory task did not yield a significant main effect (Table 4). The main effect of condition over DID, PTSD and HC participants revealed that increased task load coincided with a significant increase of reaction time (RT), while the correct responses (CR) decreased significantly ($F(2.39, 102.95)= 37.77$, $p<.001$). The Interaction Group x Condition was not significant for either RT or CR, hence task performance was similar over all three groups. We did not find significant results when testing whether dissociative symptoms, traumatic experiences, sleep quality and fantasy predicted working memory performance in terms of RT or CR.

4. Discussion and conclusion

The current study investigated the relationship between dissociative symptoms, sleep disturbance, traumatic events, fantasy proneness, and working memory performance. Our most important finding is that sleep disturbances did not predict dissociative symptoms when controlling for traumatic experiences. This finding supports a trauma model of dissociative symptoms. Further, traumatic experiences predicted dissociative symptoms better than either sleep disturbances or fantasy proneness. This finding is therefore at odds with a fantasy model. Another important finding is that we did not find superior or inferior working memory capacity in individuals with DID or individuals with PTSD as compared to HC.

One of the aims of the current study was to replicate findings of a study by van Heughten - van der Kloet et al. [34]. When including the DID and PTSD groups and not the healthy control group to avoid spurious effects, our results show a much lower sleep deprivation-dissociative symptoms correlation than the previous study, which reported a large and significant correlation [34]. Importantly, our findings are within the range reported by a large review of sleep-dissociation studies [33], whereas the sleep deprivation-dissociative symptoms correlation of the study by van Heughten - van der Kloet et al. [34] seems to be an outlier. Interestingly, when including the HC group to mimic the design of the previous study, we did replicate the highly significant finding for the sleep deprivation-dissociation association. The combined findings are in line with our hypothesis that the original results were based on a spurious effect due to the inclusion of a HC group.

Regarding sleep disturbances we did not find a difference between the DID and PTSD groups, yet a significant outcome when including HC participants. Regarding fantasy proneness, we found that it is a weak predictor of dissociative symptoms, which contrasts to the view put forward by the FM and Van der Kloet et al. [33]. According to the FM, fantasy proneness mean scores across groups were expected to be higher than those of the traumatisation measures, which was in fact, the opposite. Furthermore, it was expected to observe a difference between DID and PTSD samples, with higher mean scores for DID individuals, to suggest a causal effect of fantasy proneness on DID. We did not find any differences between the two diagnosed samples for levels of fantasy proneness, yet, similar to sleep disturbances, there were significant outcomes when the DID and PTSD individuals were compared to healthy controls. As described in the previous paragraph, correlation analyses showed an increase in strength of the effects of sleep disturbances and fantasy proneness on

psychoform and somatoform dissociation when healthy control participants are included. Taking these three findings together, we propose that fantasy proneness and sleep disturbances are factors influenced by introducing the HC sample, and are not significant in predicting DID symptomatology. It would therefore have been preferable to introduce another psychiatric diagnosis for the comparison group, such as a group of depressive patients or personality disorder patients.

When accounting for the effects of trauma, sleep disturbances and fantasy proneness lost all predictive strength on DID symptomatology. This leads us to conclude that trauma is causally related to dissociation, and that the outcomes of Van der Kloet et al. [33], suggesting sleep disturbances in combination with fantasy proneness to be the cause of DID, are inconsistent. Childhood traumatic events are linked with nightmares and dissociative experiences [46]. Hence, a relationship between sleep experiences and dissociative symptoms can be explained by traumatic experiences that cause sleep disturbances such as nightmares, hyperarousal and sleep avoidance [47] in individuals with DID or PTSD, resulting in heightened dissociative symptoms as a by-product and vice-versa [21,48]. Our results show a strong effect of traumatic experiences on DID symptomatology, even when controlling the effect of sleep disturbances. Hence, sleep disturbances, although present in traumatised individuals, cannot be considered the cause of dissociative symptoms.

Regarding cognition, we found similar working memory capacity in DID, PTSD, and healthy controls, which is in contrast to findings of previous studies [31,49,50]. One explanation is that individuals with dissociative disorders may have found ways to compensate for cognitive deficits that make these hard to detect [51]. Another explanation is that the inconsistency in findings across studies might be explained by the fact that other studies did not control for the type of personality state of the individuals with DID participating in the research, which is an important limitation. By specifically including a neutral personality state (NPS) the current study controlled for the dissociative personality state participating in the research paradigm, which is a strength of the current study. However, it would be of interest for future studies to include trauma-related personality states as well, and study personality-state-dependent working memory performance in DID [52].

Some differences in variables included in the replication versus the original study are worth noting. The original study [34] incorporated two sleep measures: the ISES and Pittsburgh Sleep Quality Inventory (PSQI). Whilst the ISES assessed for content of the sleep disturbance (for example, nightmares), the PSQI measured for the quality of sleep [53]. Our replication is in this aspect only

partial because we only included the ISES, which is the most widely used sleep measure for dissociation research [43]. Nevertheless, it will be of interest to include measures of quality of sleep in future studies. Another limitation of the present study is the relative low number of participants. It can be argued that especially the N-back is underpowered, but the sample size of the original study was even lower. For future studies we would recommend to include a non-pathological traumatised control group which has experienced both childhood and adulthood traumatic events, but is free from dissociative experiences or PTSD symptoms. The present study could not inconclusively determine whether traumatisation, sleep disturbances or fantasy proneness were responsible for PTSD group membership, so an inclusion of a traumatised healthy control sample could inform on this relationship. It is important to note our use of a cross-sectional design. We propose that future research would benefit from a mediation model approach to assess whether sleep disturbances or fantasy proneness play a causal role in dissociation as mediators of trauma. However, an improvement over the original study is that in the current study the DID participants were diagnosed by two expert clinical psychologists using the SCID-D and false positives were excluded from the current study. Another strength of our study is that it followed the future directions that the authors of the original study indicated: adding measures of traumatic experiences and replacement of the Cognitive Failure Questionnaire (CFQ) with an experimental measure to assess working memory capacity. The retrospective assessment of traumatic experiences using self-report can be seen as an almost unavoidable limitation of the current study.

The current study shows that traumatisation is the most important predictor of dissociation in individuals with DID and we assume that sleep disturbances are likely to be related to nightmares due to traumatic childhood experiences. A diagnosis of DID is still controversial [4]. When an individual presents with severe dissociative symptoms as well as sleeping problems, we recommend to check for nightmares and investigate the origin of sleep disturbances and to explore a trauma-related disorder, such as DID. This is important because individuals with DID can spend years in the mental health system before being correctly diagnosed [12]. An earlier diagnosis can therefore prevent personal suffering and personal and societal costs, especially because younger DID individuals appear to respond more rapidly to treatment than adults [54]. Although we included 17 individuals with DID instead of 12 in the original study of van Heughten - van der Kloet et al. [34], we ensured the inclusion of only individuals with genuine DID and not with imitative DID [55] by using DID-expert

clinicians for the diagnosis (see for an in depth discussion [11]). Although our findings fit our hypotheses we still need to be cautious due to the relative small sample size and high chance for type–II errors. It is therefore recommended that future studies include larger sample sizes.

This study verifies the need to focus DID treatment on managing the effect of traumatisation. This is important because there is contrasting research concerning the aetiology of the disorder, which can prevent an accurate diagnosis and treatment. Hence, the current study provides evidence for targeting traumatisation as a key predictor of dissociation in individuals with DID. The costs of under-diagnosing DID are high, not only for the individual patients, but also for their residing support system and society as a whole [4]. Sleep disturbances are an indicator of mental health suffering [56], but we propose that in DID sleep disturbances are likely to occur as a symptom due to the resurfacing of traumatic childhood experiences, not as causation of DID."

In conclusion, the current findings do not fit the hypotheses that sleep disturbances or fantasy proneness cause DID, or that DID involves working memory deficits. However, our findings are consistent with the hypothesis that chronic traumatic experiences have a major role in the aetiology of DID. Our results do not support the idea that DID is a fantasy construct.

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Table 1. Demographics, descriptive statistics and ANOVA analyses.

	Mean (SD)			ANOVA/Kruskal Wallis			Post-hoc (Mann Whitney)		
	DID (n=17)	PTSD (n=16)	HC (n=16)	Statistic	η^2	Sig. (2-tailed)	DID vs. HC	DID vs. PTSD	PTSD vs. HC
Demographics									
Age (years)	43.88 (9.86)	40.80 (12.10)	43.59 (11.68)	*F*(3.61)=0.382		n.s			
Education (years)	14.88 (0.99)	14.94 (0.85)	15.25 (0.58)	*F*(3.61)=0.415		n.s			
DES total	54.41 (16.18)	22.18 (13.83)	5.49 (3.46)	*H*(2)= 36.44**	76%	*p*<.001	*U*=272, *Z*=4.90, *p*<.001	*U*=18, *Z*=4.25, *p*<.001	*U*=23, *Z*=3.96, *p*<.001
TEC total	17.53 (4.08)	11.06 (4.01)	2 (1.93)	*H*(2)= 38.35**	64%	*p*<.001	*U*=272, *Z*=4.92, *p*<.001	*U*=25.00, *Z*=4.02, *p*<.001	*U*=5, *Z*=4.66, *p*<.001
CTQ total	88.25 (18.62)[a]	60.94 (22.70)	35.94 (8.22)	*H*(2)= 30.21**	80%	*p*<.001	*U=256*, *Z*=4.83, *p*<.001	*U*=41.5, *Z*=3.26, *p*=.001	*U*=35.5, *Z*=3.49, *p*<.001
ISES total	64.94 (18.27)	57.38 (17.31)	33.25 (12.64)	*H*(2)= 21.89**	46%	*p*<.001	*U*=21.5, *Z*=4.13, *p*<.001	n.s	*U*=29, *Z*=3.73, *p*<.001
CEQ	9.71 (5.93)	7.81 (3.51)	3.81 (3.12)	*H*(2)=10.52*	22%	*p*=.005	*U*=57.5, *Z*=2.84, *p*=.004	n.s	*U*=56.50, *Z*=2.72, *p*=.006

Note: DID= Dissociative Identity Disorder; PTSD = Posttraumatic Stress Disorder; HC=Healthy Controls; DES= Dissociative Experiences Scale; TEC= Trauma Experience Checklist; CTQ = Childhood Trauma Questionnaire; ISES= Iowa Sleep Experiences Survey; CEQ= Creative Experiences Questionnaire;
n.s.= not significant; [a]= DID (n=16) *= p≤.05; **= p≤.001.

Table 2. Pearson's partial correlation results.

	DES total	TEC	CTQ	ISES	CEQ
A: Without healthy control group **n=33 (DID n=17, PTSD n=16)**					
DES total	___	___	___	___	___
TEC total	.664**	___	___	___	___
CTQ total[a]	.651**	.628**	___	___	___
ISES total	.246	.236	-.040	___	___
CEQ	.387*	.302^	.225	.467*	___
B: With healthy control group **n=49 (DID n=17, PTSD n=16, HC n=16)**					
DES100	___	___	___	___	___
TEC total	.811**	___	___	___	___
CTQ total[a]	.792**	.808**	___	___	___
ISES total	.561**	.599**	.396*	___	___
CEQ	.561**	.543**	.457**	.656**	___

Note: *DID= Dissociative Identity Disorder; PTSD= Posttraumatic Stress Disorder; HC= healthy controls; DES= Dissociative Experiences Scale; Absp= Absorption; Amn= Amnesia; DpDr= Depersonalisation Derealisation; TEC= Trauma Experience Checklist; CTQ= Childhood Trauma Questionnaire; ISES = Iowa Sleep Experiences Survey; CEQ= Creative Experiences Questionnaire; Subscales of subsequent questionnaires presented in italics;*
[a] = DID (n=16); *= $p \leq .05$; **= $p \leq .001$; ^= $0.05 < p \leq 0.1$.

Table 3. Multiple linear regression analyses between dissociation measures (DES total, Absorption, Amnesia, Depersonalisation/Derealisation) and traumatic experiences (CTQ and TEC), sleep disturbances (ISES) and fantasy proneness (CEQ) measures in DID and PTSD.

Variable	*B*	*SE B*	*β*	R^2
DES total				
CTQ total[a]	.36	.15	.41*	.58
TEC total	1.42	.73	.33^	
ISES total	.14	.18	.12	
CEQ	.66	.64	.15	
Absorption				
CTQ total[a]	.51	.18	.54*	.46
TEC total	-.00	.89	.00	
ISES total	.24	.22	.19	
CEQ	1.04	.78	.22	
Amnesia				
CTQ total[a]	.24	.20	.24	.38
TEC total	1.82	1.01	.37^	
ISES total	.16	.25	.12	
CEQ	.30	.88	.06	
Depersonalisation/Derealisation				
CTQ total[a]	.63	.18	.58*	.59
TEC total	1.09	.89	.21	
ISES total	.22	.22	.15	
CEQ	.27	.78	.05	

Note: *DES*= Dissociative Experiences Scale; *TEC*= Trauma Experience Checklist; *ISES*= Iowa Sleep Experiences Survey; *CTQ*= Childhood Trauma Questionnaire; *CEQ*= Creative Experiences Questionnaire;
B= B value; *SE B*= Standard error of B; β= beta value;
[a] = DID (n=16); *= $p \leq .05$; **= $p \leq .001$; ^= $0.05 < p \leq 0.1$.

Table 4. Mean scores (Standard deviation) of N-back task in 3 groups: DID, PTSD and HC and Repeated ANOVA analyses.

	DID (n=14)	PTSD (n=16)	HC (n=16)	Repeated measures ANOVA	
				Statistic	**Sig. (2-tailed)**
Reaction time (milliseconds)					
				Main effect group	
0-back	461.93 (90.24)	437.69 (51.27)	444.25 (68.13)	F(2,43)=0.133	n.s.
1-back	513.93 (98.13)	495.94(103.02)	472.69 (163.15)	**Main effect condition**	
2-back	607.64 (112.99)	602.13 (131.79)	625.69 (159.85)	F(2.39, 102.95)=37.77	<.001
3-back	614.14 (143.11)	591.69 (117.92)	619.31 (156.66)	**Interaction group x condition**	
				F(4.79, 102.951)=0.40	n.s.
Correct responses					
				Main effect group	
0-back	9 (0.00)	9 (0.00)	9 (0.00)	F(2,43)=0.562	n.s.
1-back	8.93 (0.27)	8.88 (0.34)	8.88 (0.34)	**Main effect condition**	
2-back	8.43 (0.65)	8.13 (1.20)	8.50 (0.97)	F(1.80, 77.19)= 39.97	<.001
3-back	7.36 (1.22)	7.13 (.1.78)	7.44 (1.09)	**Interaction group x condition**	
				F(3.59, 77.19)=0.25	n.s.

Note: *DID*= dissociative identity disorder; *PTSD*= post=traumatic stress disorder; *HC*= healthy controls.

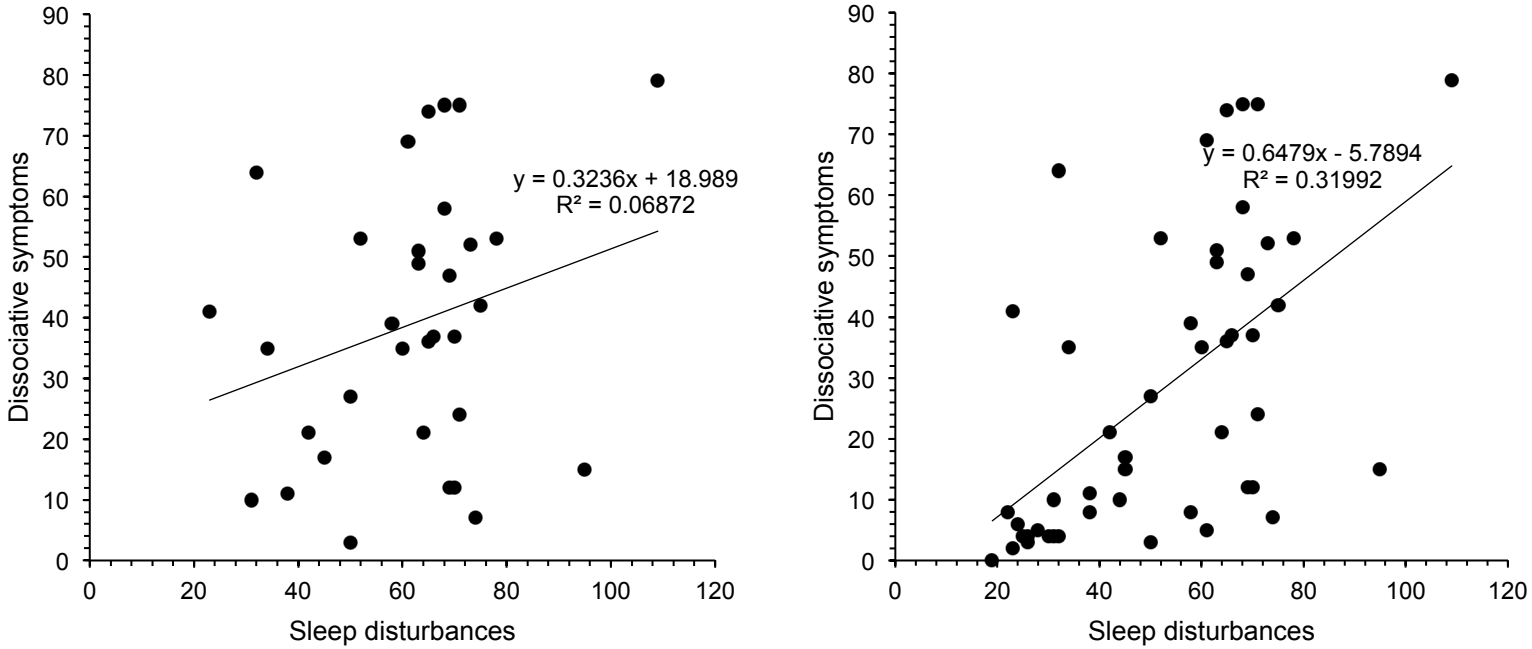

Figure 1. Correlation analyses between dissociative symptoms (DES total) and sleep disturbances (ISES total). The first scatter graph presents the relationship including only DID and PTSD participants. A moderate positive association with a weak effect size of 7% is presented (not significant), which indicates that as sleep disturbances increase, dissociative symptoms increase weakly, meaning sleep disturbances are a weak predictor of dissociative symptoms. The second scatter graph presents a correlation analysis between dissociative symptoms (DES total) and sleep disturbances (ISES total) including all participant groups (DID, PTSD and HC) ($p \leq 001$). A strong positive association with a moderate effect size of 32% is presented, which indicates that as sleep disturbances increase, dissociative symptoms increase moderately. It is found that the inclusion of healthy controls, skews the correlation, strengthening the relationship, which increases the effect of sleep on dissociative symptoms significantly.

SUPPLEMENTARY MATERIALS

For the manuscript entitled:

Sleep, Trauma, Fantasy and Cognition in Dissociative Identity Disorder, Post-traumatic Stress Disorder and Healthy Controls: A Replication and Extension Study

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Part A. ***Absorption, Amnesia, Depersonalisation-Derealisation, and Somatoform dissociation****.*

These supplementary materials present outcomes of the analyses involving the Somatoform Dissociation Questionnaire (SDQ) [1]. The SDQ involves a self-evaluation of the severity of somatoform (i.e., sensorimotor) dissociative symptoms.

Table S.1 includes Eta squared values, which indicated that the SDQ accounted for 68% of variance. There is a difference between the groups and their scores on the SDQ, with DID resulting in the highest mean score of *M*= 57.06, *SD*= 17.26, PTSD of *M*=32.69, *SD* 13.43, and the HC of *M*=21.94, *SD*= 2.35. Between the groups, DID and PTSD obtained a difference of *U*=272, *Z*=4.93, *p*<.001. Both PTSD and DID differed from HC on their scores on the SDQ, PTSD and HC resulted in *U*=38, *Z*=3.45, *p*<.001, while DID and HC in *U*=272, *Z*=4.93, *p*<.001. Partial correlations from Table S.2 present that that the SDQ correlated most with total dissociative symptoms (*r*=.820, *p*<.001) and amnesia (*r*=.777, *p*<.001), while it correlated least with fantasy proneness (*r*=.477,

$p \leq .05$). N o significant correlation was found between the SDQ and sleep disturbances. Multiple linear regressions showed childhood traumatisation (as obtained by the CTQ) as the only significant predictor for somatoform dissociation.

Table S.1 present percentages of explained variance using total scores of questionnaires. Additional analyses regarding traumatization type might be of interest for the reader and are presented here as well. Any effect of specific traumatization types, such as emotional neglect, emotional abuse, physical abuse, sexual harassment and sexual abuse, in childhood on dissociation are presented.

Table S.1. Demographics and descriptive statistics with subscales of the questionnaires (DID, PTSD and HC).

	Mean (SD)			ANOVA/Kruskal Wallis			Post-hoc (Mann-Whitney)		
	DID (n=17)	**PTSD (n=16)**	**HC (n=16)**	Statistic	η^2	P-value	DID vs. HC	DID vs. PTSD	PTSD vs. HC
Demographics									
Age (years)	43.88 (9.86)	40.80 (12.10)	43.59 (11.68)	*F*(3.61)= 0.382		n.s			
Education (years)	14.88 (0.99)	14.94 (0.85)	15.25 (0.58)	*F*(3.61)= 0.415		n.s			
DES total	54.41 (16.18)	22.18 (13.83)	5.49 (3.46)	*H*(2)= 36.44**	76%	<.001	*U*=272, *Z*=4.90, *p*<.001	*U*=18, *Z*=-4.25, *p*<.001	*U*=23, *Z*=3.96, *p*<.001
Absp	56.47 (18.79)	30.32 (20.23)	8.82 (5.79)	*H*(2)= 30.52**	64%	<.001	*U*=271, *Z*=4.90, *p*<.001	*U*=48.50, *Z*=3.15, *p*=.002	*U*=33, *Z*=3.59, *p*<.001
Amn	44.19 (22.84)	8.05 (9.43)	2.19 (2.21)	*H*(2)= 31.72**	66%	<.001	*U*=272, *Z*=4.92, *p*<.001	*U*=15, *Z*=4.37, *p*<.001	*U*=75.5, *Z*=2.02, *p*=.047
DpDr	58.63 (18.55)	16.98 (17.72)	1.35 (2.13)	*H*(2)= 37.37**	78%	<.001	*U*=272, *Z*=4.97, *p*<.001	*U*=19, *Z*=4.22, *p*<.001	*U*=18.5, *Z*=4.22, *p*<.001
SDQ	57.06 (17.26)	32.69 (13.43)	21.94 (2.35)	*H*(2)= 32.59**	68%	<.001	*U*=272, *Z*=4.93, *p*<.001	*U*=32, *Z*=3.75, *p*<.001	*U*=38, *Z*=3.45, *p*<.001
TEC total	17.53 (4.08)	11.06 (4.01)	2 (1.93)	*H*(2)= 38.35**	64%	<.001	*U*=272, *Z*=4.92, *p*<.001	*U*=25.00, *Z*=4.02, *p*<.001	*U*=5, *Z*=4.66, *p*<.001
EmNe	12.24 (3.15)	7.50 (5.82)	2.19 93.97	*H*(2)= 26.07**	54%	<.001	*U*=262, *Z*=5, *p*<.001	*U*=69.50, *Z*=-2.96, *p*=.003	*U*=195, *Z*=2.76, *p*=.006
EmAb	11.06 (4.12)	6.12 (5.36)	0.25 (1.00)	*H*(2)= 28.64**	60%	<.001	*U*=262.50, *Z*=5.02, *p*<.001	*U*=72.50, *Z*=-2.56, *p*=.012	*U*=220, *Z*=3.91, *p*<.001
PhAb	10.76 (4.56)	3.69 (4.19)	0.25 (1.00)	*H*(2)= 28.46**	59%	<.001	*U*=255, *Z*=4.78, *p*<.001	*U*=39.00, *Z*=-3.67, *p*<.001	*U*=200.50, *Z*=3.23, *p*=.001
SeHa	8.76 (5.32)	2.56 (2.58)	0.06 (0.25)	*H*(2)= 25.56**	53%	<.001	*U*=246.50, *Z*=4.40, *p*<.001	*U*=51.50, *Z*=-3.11, *p*=.002	*U*=213.50, *Z*=3.72, *p*<.001
SeAb	9.18 (5.14)	2.38 (3.07)	0 (0)	*H*(2)= 28.93**	60%	<.001	*U*=256, *Z*=4.80, *p*<.001	*U*=40.50, *Z*=-3.53, *p*<.001	*U*=200, *Z*=3.42, *p*=.001
CTQ total [a]	88.25 (18.62)	60.94 (22.70)	35.94 (8.22)	*H*(2)= 30.21**	80%	<.001	*U*=256, *Z*=4.83, *p*<.001	*U*=41.5, *Z*=3.26, *p*=.001	*U*=35.5, *Z*=3.49, *p*<.001
EmNe	21.81 (2.90)	16.63 (6.02)	10.44 (4.27)	*H*(2)= 24.74**	53%	<.001	*U*=252.50, *Z*=4.71, *p*<.001	*U*=62, *Z*=-2.50, *p*=.012	*U*=205.50, *Z*=2.93, *p*=.003
PhNe	16.56 (4.37)	10.50 (3.93)	7.44 (2.31)	*H*(2)= 26.90**	57%	<.001	*U*=252.50, *Z*=4.71, *p*<.001	*U*=35.50, *Z*=-3.50, *p*<.001	*U*=193, *Z*=2.48, *p*=.013
EmAb	19.69 (4.61)	14.44 (6.31)	7.44 (2.50)	*H*(2)= 26.62**	57%	<.001	*U*=254, *Z*=4.77, *p*<.001	*U*=65, *Z*=-2.39, *p*=.017	*U*=217.50, *Z*=3.40, *p*=.001
PhAb	14.00 (6.02	9.31 (4.84)	5.38 (1.26)	*H*(2)= 23.43**	50%	<.001	*U*=243, *Z*=4.58, *p*<.001	*U*=67, *Z*=-2.31, *p*=.021	*U*=205, *Z*=3.27, *p*=.001
SeAb	16.19 (7.26)	10.06 (6.06)	5.25 (0.68)	*H*(2)= 23.65**	50%	<.001	*U*=247, *Z*=4.74, *p*<.001	*U*=63, *Z*=-2.47, *p*=.013	*U*=191, *Z*=2.80, *p*=.005
ISES Total	64.94 (18.27)	57.38 (17.31)	33.25 (12.64)	*H*(2)= 21.89**	46%	<.001	*U*=21.5, *Z*=4.13, *p*<.001	n.s	*U*=29, *Z*=3.73, *p*<.001
Gen	57.88 (16.83)	50.81 (14.81)	28.63 (10.22)	*H*(2)= 21.93**	46%	<.001	*U*=21.5, *Z*=4.13, *p*<.001	n.s	*U*=27.5, *Z*=3.79, *p*<.001

Lucid	7.06 (4.07)	6.56 (4.34)	4.63 (2.80)	$H(2)= 4.87$^	10%	=.09	$U=83.5$, $Z=1.97$, $p=.058$^	n.s	$U=81$, $Z=1.84$, $p=.08$
CEQ	9.71 (5.93)	7.81 (3.51)	3.81 (3.12)	$H(2)= 10.52$*	22%	=.005	$U=57.5$, $Z=2.84$, $p=.004$	n.s	$U=56.50$, $Z=2.72$, $p=.006$

Note: *DID*= Dissociative Identity Disorder; *PTSD* = Posttraumatic Stress Disorder; *HC*=Healthy Controls; *DES*= Dissociative Experiences Scale; *Absp*= Absorption; *Amn*= Amnesia; *DpDr*= Depersonalisation Derealisation; *SDQ*= Somatoform Dissociation Questionnaire full version; *TEC*= Trauma Experience Checklist; *EmNe*= Emotional Neglect; *EmAb*= Emotional Abuse; *PhAb*= Psychical Abuse; *SeHa*= Sexual Harassment; *SeAb*= Sexual Abuse; *CTQ* = Childhood Trauma Questionnaire; *PhNe*= Physical Neglect; *ISES*= Iowa Sleep Experiences Survey; *Gen*= General; *CEQ*= Creative Experiences Questionnaire; *Subscales of subsequent questionnaires presented in italics;*
n.s.= not significant; [a] = DID (n=16); *= $p \leq .05$; **= $p \leq .001$; " ^= $0.05 < p \leq 0.1$.

Table S.2 Pearson's partial correlations including subscales of the DES and the SDQ.

	DES total	Absp	Amn	DpDr	SDQ	TEC	CTQ	ISES	CEQ
A: Without healthy control group **n=33 (DID n=17, PTSD n=16)**									
DES total	___	___	___	___	___	___	___	___	___
Absp	.867**	___	___	___	___	___	___	___	___
Amn	.889**	.689**	___	___	___	___	___	___	___
DpDr	.878**	.764**	.717**	___	___	___	___	___	___
SDQ	.820**	.694**	.777**	.652**	___	___	___	___	___
TEC total	.664**	.450*	.573**	.621**	.610**	___	___	___	___
CTQ total[a]	.651**	.586**	.484*	.714**	.634**	.628**	___	___	___
ISES total	.246	.261	.230	.194	.324^	.236	-.040	___	___
CEQ	.387*	.419*	.290	.305^	.477*	.302^	.225	.467*	___
B: With healthy control group **n=49 (DID n=17, PTSD n=16, HC n=16)**									
DES100	___	___	___	___	___	___	___	___	___
Absp	.925**	___	___	___	___	___	___	___	___
Amn	.900**	.768**	___	___	___	___	___	___	___
DpDr	.924**	.853**	.791**	___	___	___	___	___	___
SDQ	.875**	.794**	.831**	.770**	___	___	___	___	___
TEC total	.811**	.706**	.675**	.775**	.738**	___	___	___	___
CTQ total[a]	.792**	.750**	.630**	.821**	.753**	.808**	___	___	___
ISES total	.561**	.570**	.450*	.505**	.556**	.599**	.396*	___	___
CEQ	.561**	.579**	.435*	.497**	.590**	.543**	.457*	.656**	___

Note: *DID= Dissociative Identity Disorder; PTSD= Posttraumatic Stress Disorder; DES= Dissociative Experiences Scale; Absp= Absorption; Amn= Amnesia; DpDr= Depersonalisation Derealisation; SDQ= Somatoform Dissociation Questionnaire full version; TEC= Trauma Experience Checklist; CTQ= Childhood Trauma Questionnaire; ISES = Iowa Sleep Experiences Survey; CEQ= Creative Experiences Questionnaire; Subscales of subsequent questionnaires presented in italics;*
[a] = DID (n=16); *= $p \leq .05$; **= $p \leq .001$; ^= $0.05 < p \leq 0.1$.

Table S.3 Multiple linear regression analyses between dissociation measures (DES total, Absorption, Amnesia, Depersonalisation/Derealisation, and SDQ) and traumatic experiences (CTQ and TEC), sleep disturbances (ISES) and fantasy proneness (CEQ) measures in DID and PTSD.

Variable	*B*	*SE B*	*β*	R^2
DES total				
CTQ total[a]	.36	.15	.41*	.58
TEC total	1.42	.73	.33^	
ISES total	.14	.18	.12	
CEQ	.66	.64	.15	
Absorption				
CTQ total[a]	.51	.18	.54*	.46
TEC total	-.00	.89	.00	
ISES total	.24	.22	.19	
CEQ	1.04	.78	.22	
Amnesia				
CTQ total[a]	.24	.20	.24	.38
TEC total	1.82	1.01	.37^	
ISES total	.16	.25	.12	
CEQ	.30	.88	.06	
Depersonalisation/Derealisation				
CTQ total[a]	.63	.18	.58*	.59
TEC total	1.09	.89	.21	
ISES total	.22	.22	.15	
CEQ	.27	.78	.05	
SDQ				
CTQ total[a]	.37	.13	.48*	.58
TEC total	.75	.64	.20	
ISES total	.20	.16	.20	
CEQ	.73	.56	.19	

Note: *DES*= Dissociative Experiences Scale; *SDQ*= Somatoform Dissociation Questionnaire full version; *TEC*= Trauma Experience Checklist; *ISES*= Iowa Sleep Experiences Survey; *CTQ*= Childhood Trauma Questionnaire; *CEQ*= Creative Experiences Questionnaire;
B= B value; *SE B*= Standard error of B; β= beta value;
[a] = DID (n=16); *= $p \leq .05$; **= $p \leq .001$; ^= $0.05 < p \leq 0.1$.

SUPPLEMENTARY MATERIALS

For the manuscript entitled:

Sleep, Trauma, Fantasy and Cognition in Dissociative Identity Disorder, Post-traumatic Stress Disorder and Healthy Controls: A Replication and Extension Study

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Part B. *Creative experiences questionnaire (CEQ)*

This part of the supplementary materials describes the Pearson's partial correlations between individual items of the CEQ and DES scores (Total, Absorption, Amnesia and Depersonalisation-Derealisation) and between individual items of the CEQ and SDQ scores. Table S.4 shows the outcomes of the analyses between the CEQ [2] subscales and dissociative symptoms as measured by the DES and SDQ. Correlation analyses were ran on diagnosed groups (DID and PTSD) only as to avoid spurious effects of a non-pathological group on pathological symptoms.

Partial correlations, controlling for years of education, revealed that the strongest associations are between DES total and Q3 ("As a child, I had my own make believe friend or animal.") (r=.494, p=.004) and between DES total and Q5 ("As a child, I sometimes had the feeling that I was someone else (e.g., a princess, an orphan, etc.)") (r=.507, p=.003). DES total also correlated positively with Q2 ("As a child, I strongly believed in the existence of dwarfs, elves, and other fairy tale figures.") (r=.397, p=.024), Q7 ("As a child, I often felt lonely.") (r=.366, p=.039), Q21 ("I often have the feeling that I can predict things that are bound to happen in the future.") (r=.374, p=.035), Q23 ("I sometimes feel that I have an out of body experience.") (r=.376, p=.034) and Q25 ("During my life, I have had intense religious experiences which influenced me in a very strong manner.") (r=.396, p=.025). There were two negative correlation between DES total and Q4 ("As a child, I could very easily identify with the main character of a story and/or movie.") (r=-.362, p=.042), and DES total and Q6 ("As a child, I was

encouraged by adults (parents, grandparents, brothers, sisters) to fully indulge myself in my fantasies and daydreams.") (*r*=-.411, *p*=.020).

Correlation analyses between the DES Absorption and CEQ questions resulted in significant positive correlations most strongly with Q5 (*r*=.471, *p*=.007) and Q21 (*r*=.491, *p*=.004). DES Absorption also positively correlated with Q3 (*r*=.414, *p*=.017) and Q20 ("When I imagine I have eaten rotten food, I really get nauseous.") (*r*=.397, *p*=.025). There was one negative correlation between DES Absorption and Q6 (*r*=-.380, *p*=.032).

Correlation findings for the DES Amnesia and the CEQ questions showed positive correlations for Q3 (*r*=.494, *p*=.004) and Q5 (most strongly: *r*=.544, *p*=.001). There was one negative correlation between DES Amnesia and Q16 ("When I recall my childhood, I have very vivid and lively memories.") (*r*=-.356, *p*=.045).

Correlation analyses between the DES Depersonalisation/Derealisation and CEQ questions resulted in significant correlations with Q3 (*r*=.439, *p*=.012), Q5 (*r*=.408, *p*=.020), Q7 ("As a child, I often felt lonely.") (*r*=.457, *p*=.009), Q23 (*r*=.370, *p*=.037) and Q25 ("During my life, I have had intense religious experiences which influenced me in a very strong manner") (*r*=.448, *p*=.010). There was one negative correlation between DES Depersonalisation/Derealisation and Q6 (*r*=-.355, *p*=.046).

Finally, the correlations between the SDQ and CEQ questions revealed the strongest positive correlations with Q3 (*r*=.651, *p*<.001) and Q5 (*r*= .574, *p*=.001). The SDQ also positively correlated with: Q1 ("As a child, I thought that the dolls, teddy bears, and stuffed animals that I played with were living creatures.") (*r*=.470, *p*=.007), Q2 (*r*=.493, *p*=.004), Q10 ("Many of my fantasies have a realistic intensity.") (*r*=.434, *p*=.013), Q20 (*r*=.379, *p*=.032); Q21 (*r*=.360, *p*=.043), Q23 (*r*=.410, *p*=.020), Q23 (*r*=.410, *p*=.020), Q24 ("When I sing or write something, I sometimes have the feeling that someone or something outside myself directs me.") (*r*=.412, *p*=.019), and Q25 (*r*=.352, *p*=.048).

Overall, correlation analyses indicate that Q3 ("As a child, I had my own make believe friend or animal") and Q5 ("As a child, I sometimes had the feeling that I was someone else (e.g., a princess, an orphan, etc.") as the questions which drive the significant associations between dissociation and fantasy proneness. The CEQ questions Q3 and Q5 correlate with all measures of the DES that were analysed.

Table S.4. Partial correlation with all questions of the CEQ and psychoform (DES total, Absorption, Amnesia, Depersonalisation/Derealisation) and somatoform (SDQ) dissociative symptoms.

Questions	DES total	Absorption	Amnesia	Depersonalisation /derealisation	SDQ
Q1	.263	.214	.298^	.292	.470*
Q2	.397*	.286	.311^	.336^	.493*
Q3	.494*	.419*	.494*	.439*	.651**
Q4	-.362*	-.345^	-.341^	-.266	-.332^
Q5	.507*	.471*	.544**	.408*	.574**
Q6	-.411*	-.380*	-.316^	-.355*	-.345^
Q7	.366*	.251	.256	.457*	.282
Q8	.220	.219	.253	.280	.332^
Q9	-.036	-.040	-.004	.035	.136
Q10	.326^	.226	.248	.191	.434*
Q11	.253	.220	.200	.075	.269
Q12	.199	.116	.108	.112	.127
Q13	.220	.217	.239	.277	.123
Q14	.043	.117	.043	-.047	-.049
Q15	-.060	.010	.023	-.055	-.030
Q16	-.261	-.141	-.356*	-.289	-.302^
Q17	.098	.335^	.101	-.104	.025
Q18	-.084	.041	-.090	-.017	-.069
Q19	.049	.207	-.060	-.003	.181
Q20	.340^	.397*	.195	.317^	.379*
Q21	.374*	.491*	.234	.244	.360*
Q22	-.057	.158	-.075	-.159	.056
Q23	.376*	.235	.309^	.370*	.410*
Q24	.319^	.222	.212	.281	.412*
Q25	.396*	.325^	.261	.448*	.352*

Note: ***Q1****: As a child, I thought that the dolls, teddy bears, and stuffed animals that I played with were living creatures.;* ***Q2****: As a child, I strongly believed in the existence of dwarfs, elves, and other fairy tale figures.;* ***Q3****: As a child, I had my own make believe*

*friend or animal.; **Q4**: As a child, I could very easily identify with the main character of a story and/or movie.; **Q5**: As a child, I sometimes had the feeling that I was someone else (e.g., a princess, an orphan, etc.).; **Q6**: As a child, I was encouraged by adults (parents, grandparents, brothers, sisters) to fully indulge myself in my fantasies and daydreams.; **Q7**: As a child, I often felt lonely.; **Q8**: As a child, I devoted my time to playing a music instrument, dancing, acting, and/or drawing.; **Q9**: I spend more than half the day (daytime) fantasizing or daydreaming.; **Q10**: Many of my friends and/or relatives do not know that I have such detailed fantasies.; **Q11**: Many of my fantasies have a realistic intensity.; **Q12**: Many of my fantasies are often just as lively as a good movie.; **Q13**: I often confuse fantasies with real memories.; **Q14**: I am never bored because I start fantasizing when things get boring.; **Q15**: Sometimes I act as if I am somebody else and I completely identify myself with that role.; **Q16**: When I recall my childhood, I have very vivid and lively memories.; **Q17**: I can recall many occurrences before the age of three.; **Q18**: When I perceive violence on television, I get so into it that I get really upset.; **Q19**: When I think of something cold, I actually get cold.; **Q20**: When I imagine I have eaten rotten food, I really get nauseous.; **Q21**: I often have the feeling that I can predict things that are bound to happen in the future.; **Q22**: I often have the experience of thinking of someone and soon afterwards that particular person calls or shows up.; **Q23**: I sometimes feel that I have an out of body experience.; **Q24**: When I sing or write something, I sometimes have the feeling that someone or something outside myself directs me.; **Q25**: During my life, I have had intense religious experiences which influenced me in a very strong manner.*

*= $p \leq .05$; **= $p \leq .001$; ^= $0.05 < p \leq 0.1$.

Part C. ***Power Analyses.***

G-power [3] analyses were conducted to determine sample sizes. The Type I error probability associated with this test of the null hypothesis was 0.05 and the planned tests were one-tailed. The multiple linear regressions used for testing hypothesis 2 show that that a sample size of 10 would be sufficient regarding the total DES scores, with an effect size of 1.38 and actual power of 0.95. Furthermore, to examine the effect of sleep disturbances and fantasy proneness on the subscales of the DES, namely absorption (effect size 0.85, actual power 0.96), amnesia (effect size 0.61, actual power 0.96) and depersonalisation/derealisation (effect size 1.44, actual power 0.96), G-power analyses showed sufficient sample sizes of 15, 20 and 10 respectively. Our sample size meets the required numbers for two out of three analyses. Of note, the sample size of van Heughten - van der Kloet et al. did not meet any of the required number of patients.

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